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Dear John

Notes on the feasibility of using rotenone (cube root powder) to eradicate exotic fish in the Serpentine lakes complex

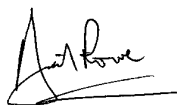
1. The report by Waterways Environmental Services (WES) on the feasibility of using rotenone in the Serpentine Lakes to eradicate pest fish (Dean-Speirs, undated) has fully covered most of the issues involved in this project and provides a comprehensive, expert assessment of the feasibility of removing rudd and catfish. However, this report does not refer to publications on the Parkinson's Lake project in which rudd (and all other fish) were successfully eradicated from a small New Zealand lake (e.g. Rowe & Champion 1994). Neither does it refer to the DOC reports on the eradication of gambusia in Nelson ponds, or the eradication of gudgeon in an Auckland lake. Admittedly these operations may have occurred after the report was prepared. Such omissions do not affect the main conclusions of the report, but there are a few technical details arising from this combined New Zealand experience that can be added to the current knowledge and plans for the Serpentine lakes so expertly described by Dean-Speirs (undated). These are listed below.
2. The WES report concludes that rudd are more likely to be eradicated from the Serpentine Lakes than catfish. The NZ experience in which rudd were eradicated from Parkinson's Lake supports this conclusion but this eradication was accomplished in a more structurally simple and smaller waterbody. Even so, the main limitation to rudd eradication here was the presence of larvae (adhering to the underside of vegetation) and fry (< 30 mm TL), which school in shallow water amongst dense marginal vegetation. To eradicate rudd, the marginal vegetated habitat for these juvenile life stages needs to be treated successfully, or the seasonal timing of eradication selected to avoid their presence.
3. If the marginal, vegetated habitats are to be treated successfully, DOC experience in eradicating gambusia in Nelson has shown that using a high pressure fire-hose to force mixing of rotenone into all marginal waters works. This approach would need to encompass the entire margin of each lake as well as the wetland areas and drains to successfully eradicate rudd. It would need to penetrate the deeper water among rush beds to ensure no refugia remain. This possibility could be readily field tested in a small partitioned section of the lake in the pre-treatment bioassay recommended by the WES report.
4. The WES report recommends a pre-treatment bioassay approach to establish an optimal rotenone concentration for this lake complex. However, bioassays also need to be included in the actual treatment. These typically involve the placement of caged fish (e.g. catfish or goldfish) in deep waters and in places where mixing may be difficult to achieve. If these fish die post-treatment, then there can be confidence in the mixing regime. However, if they live then the mixing regime will need to be re-evaluated for any repeat treatment. As indicated above, this could be included in the pre-treatment bioassay as well.

5. The seasonal timing of treatment is important (Dean-Speirs undated). This is particularly so when considering rudd eradication because experience of this fish in NZ indicates that it has an extended annual breeding season (spring to autumn) with up to three cohorts being produced per year (unpubl. data). The Parkinson's Lake rotenone application was scheduled for spring and before rudd spawned because most rudd would be at least one year old and no larvae or fry would be present at that time. The water temperature in spring was known to be cool and the lake was isothermal allowing easier mixing. This strategy proved to be successful. However, spawning times can vary between lakes and years depending on fish condition. If the fish are in poor condition (i.e. limited lipid reserves) either because winter has been colder, or fish numbers have been high and food scarce, spawning can be delayed by 1-4 weeks. Conversely, as a result of seasonally changing weather conditions spawning can occur earlier in some years than in others. Information on the annual time of first spawning for rudd in this lake complex would be useful in setting a time for this exercise. Examination of the gonad states of samples of fish taken fortnightly between August and October (combined with data on water temperature and fish condition) would assist with this. Application of rotenone in winter, summer and autumn is likely to be less successful because of problems with either cold water (fish in hibernation mode), hot water (detoxifies rotenone), thermal stratification (resists mixing), or the presence of larvae and fry (can escape treatment).
6. Careful attention needs to be given to identifying all inlet and outlet drains that could act as refugia and which may need special treatment (Dean-Speirs, undated). The lake beds should also be scanned for other fish refugia (e.g. log dams or debris) requiring special treatment. Several large logs were present in Parkinson's Lake (detected by SCUBA surveys) and care was taken to ensure rotenone was concentrated and mixed around these as well as in the inlet and outlet drains.
7. The WES report notes that dead fish may sink to the bottom and decay thereby producing a short-term risk of a deterioration in water quality. This was averted in Parkinson's Lake by teams of dip-netters working from boats in pre-agreed sectors of the lake netting out dying or dead fish at the lake surface during the treatment. Virtually all fish affected by rotenone move towards the surface (1-4 hours post treatment) as an initial response to this chemical. Some then die at the surface and float whereas others sink (especially if they have been feeding recently and have full stomachs). Many fish that sink will eventually surface (2-4 days later depending on water temperature) and can be recovered then. Such post-treatment fish collection is required if SCUBA divers find that large number are present on the lake bed after treatment. Post-treatment collection avoids concentrations of unsightly carcasses washing up onto the lake shore where gulls and other scavengers feed on them. A further benefit arising from teams of dip-netters to recover fish during treatment is that native fish that are recovered (e.g. eels) can be placed in clean, cool water (and/or water containing potassium permanganate) and will generally recover. They can then be returned to the lake.
8. There was limited comment on the overall treatment strategy but it was apparent from the report that barriers were being considered to isolate the lakes. If the lakes are temporarily isolated by barriers, then there would be some scope for artificially lowering water levels by pumps to temporarily expose marginal vegetation and encourage fish emigration from wetland areas (and drains) into the lake. This would facilitate rotenone treatment. In this event, treatment would need to proceed from the highest to the lowest waterbody. Alternatively, the weir that was recently installed on the lowest lake's outlet may result in an overall rise in water level and remove many of the connections and wetlands. If a temporary increase in water level is possible (by increasing the weir height) this would facilitate treatment of the entire water body in a single day and also avoid some of the 'refugia' and mixing problems created by marginal vegetation.
9. A jet-boat is mentioned as an efficient way of mixing rotenone into deeper water. This was not needed in the deeper waters of Parkinson's Lake (7 m deep) where mixing was successfully achieved by pumping rotenone via a 12 volt bilge pump through a weighted pipe into the lake

water. Subsequent mixing by a large number of outboard motors (approx. 5 per ha with extra weight in the stern to direct propeller wash into deeper waters) helped ensure further mixing of rotenone into both surface and bottom waters. A jet-boat would be more efficient than outboard motors but in the shallower waters (< 4 m) of the Serpentine Lakes it may be too efficient and suspend large amounts of silt from the lake bed into the water column thereby accelerating detoxification of the rotenone.

10. The WES feasibility report dealt primarily with the technical limitations, but there are also some regulatory and social issues that need to be considered as these will influence the management goal and feasibility of this operation. The need for a resource consent could be a major constraint. If the lakes' water is used for stock watering or potable water supply alternative supplies may be required. If the consent needs to be publically notified, opposition could develop from a range of groups. Concerns have been raised on the internet about the role of rotenone in Parkinson's disease and whereas the evidence for this is limited, it can be expected to result in some public opposition allied to generalised fears over the use of chemicals in aquatic environments. Similarly, coarse fishing groups may oppose the application. Where opposers primary arguments against the application may be readily dealt with in evidence, they will also raise and scrutinise other arguments to bolster their opposition. These other arguments can be expected to include justification of the overall cost/benefit of the operation. In this respect, there is still limited evidence that rudd pose a threat to native macrophytes in NZ lakes and there are a number of water bodies around the North Island where rudd and macrophytes have co-existed for periods of 20+ years. A counter to this, is that eradication seeks to remove rudd, catfish and goldfish, not just rudd. This stance is backed by scientifically defensible (i.e. published) information confirming that mixtures of alien fish species in New Zealand cause a more rapid deterioration of lake water clarity (and hence the demise of macrophytes) than single fish species (Rowe 2007; Schallenberg & Sorrell 2009). The problem with this stance is that it may not be feasible to eradicate catfish in the Serpentine Lakes.
11. The WES report indicated that there was a high probability of removing rudd, but that the feasibility of removing catfish was lower. Goldfish are also present and the feasibility of eradicating them can be expected to lie between that of rudd and catfish. Although examples of catfish eradication using rotenone are referred to in the report, these can be expected to have occurred mainly in structurally simple environments where rotenone mixing is easily achieved. The Serpentine lakes form a structurally complex environment and hence the feasibility of eradicating catfish here will be low and dependent on repeat applications.
12. A repeat rotenone treatment is recommended by the WES report and is valid because of; (a) the technical difficulty of using a single treatment to achieve complete eradication of rudd, and especially catfish, in this structurally complex environment and (b) the ERMA limitation on maximum concentration which prevents deliberate use of an 'overkill' concentration, which is advisable where eradication is the aim. The WES report recommends 2-3 repeat treatments over a 12 month period. Even with this approach, it would have to be acknowledged that catfish may not be eradicated and that the cost of removing catfish will be much higher than the cost of removing rudd and goldfish. Such considerations will have a bearing on the management goal to be achieved with this operation. Removal of rudd and goldfish maybe a more defensible goal than removal of all exotic species, even though the latter may also be achieved.

Yours faithfully



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References

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